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ABSTRACT

Investigated were the effects of type of strategy training, intersession interval, and a posttraining reminder cue on paired associates learning for 57 educable mentally retarded elementary school children. Ss were assigned to one of four training conditions (sentence mediation, visual imagery mediation, combined sentence and imagery training, or a control group receiving practice without training); each group was divided into subgroups according to the interval (1 day, 1 week, or 2 weeks) between their two training sessions; and all groups received pretraining and posttraining assessments. Results indicated that posttest transfer was obtained under all training conditions, that posttraining reminder cues boosted performance, and that significant interactions between strategy and interval occurred (although neither factor differentially affected performance when taken above). (LH)

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MEDIATED PAIRED-ASSOCIATES LEARNING IN AN EMR POPULATION: THE EFEECT OF TYPE OF STRATEGY, INTERSESSION INTERVAL, AND REMINDER CUE[1]

Abstract

Paired-associates learning was studied in an EMR population to determine the relative effectiveness of different types of mediational strategies and different intervals between training sessions. The strategies investigated were sentence mediation, visual imagery mediation, and a combination of the two. Under all training conditions transfer to a posttest was obtained. For all trained subjects, performance was further boosted by a brief reminder of the strategy training during the posttest. There were no significant differences among the three strategy training groups when compared across intersession intervals used in training, but significant interactions between strategy and interval did occur. The visual imagery group showed best posttest performance after a one-day interval between training sessions, the sentence mediation group showed best posttest performance after a one-week intersession interval, and the combined strategy training group performed best after a two-week training interval.

MEDIATED PAIRED-ASSOCIATES LEARNING IN AN EMR POPULATION: THE EFFECT OF TYPE OF STRATEGY, INTERSESSION INTERVAL, AND REMINDER CUE[1]

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Representative studies (e.g., Jensen & Rohwer, 1963a and 1963b; MacMillan, 1970; and Mankinen, 1971) have shown that sentence mediation training facilitates paired-associates learning in educable mentally retarded (EMR) children and adults. However, there is no experimental evidence that such stragegy training transfers to new stimulus materials. This failure has been taken to mean that although the learning rate of the EMR is facilitated by the introduction of a strategy, there is question about his ability to sustain or to spontaneously produce mediation on his own.

Gampel and Stein (1973) have shown that the lack of strategy transfer seen among EMRs occurs in nonretarded populations as well. The hypothesized deficit in the "spontaneous production" of mediation may not be unique to the retarded under typical training conditions. In their study, subjects who were taught to construct sentences linking picture pairs and instructed to use sentences as a mnemonic device showed no significant gain in performance on the post-training trials in which they had to learn a new 18-picture

pair list. When some subjects were later reminded of the previous training, their scores increased dramatically despite the fact that they were presented with unfamiliar picture pairs and were required to generate their own sentences.

The authors present a production-deficiency (Flavell, 1970) explanation of these findings. They suggest that the subjects in the study were not able to spontaneously produce the appropriate problem-solving strategy in a novel situation despite their demonstrated ability to utilize the strategy. The one-time training program was inadequate to produce longer term improvement. The reminder served to make the obvious connection between the general rule and the specific task which led to improved performance. It is possible that retarded subjects are particularly deficient in the verbal skills necessary to represent the training as a general strategy applicable across a wide variety of tasks. For example, Jensen (1968) notes that EMRs are less likely than normal children to spontaneously verbalize the requirements of a task and monitor their performance verbally. These subjects would therefore be dependent on an external presentation of clearcut instructions in order to profitably utilize a learning strategy.

In the current study, the informal finding of the success of the reminder was systematically investigated. It was hypothesized that a distinction must be made between the

training of a strategy and the utilization of a strategy. Consequently, the training sessions included an emphasis on the usefulness of the strategy and instructions to remember to use the strategy again. In the posttraining session, all trained subjects were given two trials requiring spontaneous application of the strategy, followed by instructions reminding them of the prior training strategy and then two more posttraining trials.

The experiment also compared the effectiveness of sentence mediation training with a procedure that instructs the S to construct visual images as links for the pairs to be learned. Paivio (1971) has shown that immediate and delayed recall of concrete nouns is enhanced for children and adults when they are instructed to form images of the words to be learned. Rohwer (1970) and Gupton and Fricke (1970) have also demonstrated the effectiveness of imagery training. The imagery training was added in order to investigate the dimensions of strategy training in a more general context.

Turnure and Thurlow (1973) argue that EMRs may require more than one training session to grasp and apply the mediation strategy. Research findings support this conclusion with normal children as well. We have noted that limited training may be insufficient to overcome a production deficiency. In this study, all subjects had two training sessions. The effects of three different time distributions of these two

training sessions in the use of the sentence and imagery strategy were also studied.

Thus, the main purpose of this experiment was not to determine whether IQ-defined educable retarded children an be trained to use a more productive learning style through instruction, but to determine the conditions which best facilitate their active use of a learning strategy. The variables investigated were 1) kind of strategy instructions (sentence mediation, imagery mediation, both combined, and control), 2) intersession training interval (one day, one week, two weeks), and 3) a reminder during the posttraining session.

Method

Experimental Design

All experimental subjects received two training sessions as well as pretraining and posttraining assessment. Subjects were assigned to one of four training conditions: visual imagery training, sentence mediation training, imagery and sentence training combined, or a control group receiving practice without training. Each of these groups was further divided into three subgroups according to interval between the two training sessions: these were one day, one week, or two weeks. All groups were seen in a posttraining interview two weeks after the second training session.

Subjects

The subjects were 57 EMR children in the elementary

schools of an industrial city in the Greater Boston area. The experimental and control groups were formed prior to the beginning of the experiment. Ss were assigned to groups such that mean MA, CA and IQ were equivalent for each group. Table 1 summarizes the CA, MA, and IQ data for each group.

Insert Table 1 about here

Materials

Materials consisted of three 18-item sequences of picture-paired associates (List A, B and C). The lists were matched for difficulty on the basis of an item analysis of the results from a previous study (Gampel & Stein , 1973). Each pair consisted of pictures of two common and easily named, but unrelated, objects mounted on a slide. In addition, there were slides containing only the stimulus items for each pair. A Kodak Carousel projector, set at a distance to project an image of 11" x 15" of each picture was used to present the slides. Photographs of common objects mounted on cardboard were used in the familiarization phase of the study.

Procedure

Each subject was seen individually by one of two experimenters three times, the spacing of the three sessions varying according to group placement. Each of the three sessions took about 25 minutes per subject. Subjects received the

TABLE 1

Mean CA, MA, and IQ for All Subject Groups

	CA[a]	MA[a]	IQ
Imagery training group			
One day	10.75	7.92	75.00
One week	10.83	7.92	72.80
Two weeks	11.00	7.25	67.80
Sentence training group			
One day	10.67	7.67	74.40
One week	11.08	7.92	72.00
Two weeks	10.92	8.00	74.50
Combined training group			
One day	10.75	8.17	77.20
One week	10.75	8.00	75.20
Two weeks	10.83	8.00	74.60
Control group			
One day	10.67	7.75	73.00
One week	10.83	7.83	73.00
Two weeks	10.33	7.58	74.00

[a]In years.

same list for all trials of each session, but a new list each session. The order of picture-pair lists was randomized across conditions and sessions to avoid effects of any remaining bias in the lists.

Session 1, Part A: Familiarization Trials

Three picture pairs (in the form of pictures mounted on cardboard) not used in the experiment were used to familiarize subjects with the task. They were asked to name the objects pictured and told that they were to remember which pictures went together so that when they saw only one of the pictures from a pair, they could say the name of the picture that it was paired with. Any subject who failed to get the pretraining sequence of these pairs correct (ORANGE-GLOVE, CUP-SHOE, AIRPLANE-FORK) was dropped from the sample. All subjects successfully completed this practice task.

Session 1, Part B: Pretraining

Following these introductory trials, all subjects were presented with 18 consecutive pictures pairs (List A, B, or C) projected on a screen at 8-second intervals. Subjects were asked to say the name of each picture and try to remember which pictures went together. The experimenter provided the correct label if the subject was unable to name a picture, and used S's label if it differed from the expected one (i.e., S might call the "hatchet" an "axe "). Following the first exposure to the 18 pairs, 18 slides showing just the stimulus

member of each pair in random order were presented at 8-second intervals. After naming each picture, the subject was to say the name of the missing response picture. This study-test sequence constituted one trial, and was repeated twice. The experimenter told the subject when he was correct and kept a record of all responses.

Session 1, Part C: Training

Following the pretraining, subjects in the 9 experimental groups were told that this time they were going to learn a way to help them to remember the picture pairs. Subjects in the three sentence mediation groups were instructed to make up a sentence about each picture pair. E explained that the sentence would help the subject to remember the missing picture when he saw just one picture. Subjects in the three imagery mediation groups were instructed to try to make a picture in their minds of the two picturss in each pair together and were similarly encouraged to use the pictures in their minds to help them to remember the missing items.

Training Instructions for Sentence Mediation Conditions
(Instructions for Imagery Training in Parentheses)

I'm going to tell you about a special way that will help you remember what pictures go together. We'll make up a sentence about the two pictures (we'll try to picture in our minds both of the pictures together) each time. When you see just one of the pictures, the sentence (the picture of

the two pictures together) will help you remember the other picture. Let's try one. (E shows the first slide, e.g., arrow and leaf.) The arrow made a hole in the leaf. Now you say the sentence. (Close your eyes and try to make a picture of the leaf with the arrow through it. Can you see it in your mind? Now you have one picture in your mind of the two pictures together.) The sentence (picture of the two pictures together) will help you remember what goes with what. (E shows the next slide and gives the sentence or image.)

Two study-test trials were administered in this way. Subjects receiving both sentence and imagery training were given both kinds of instructions ("sentence" for one study-test trial and "imagery" for the other). Half received the sentence training for trial 1 and half received the imagery training first. The three control groups continued with the pretraining procedure for two more trials. After the session, the experimenter told the subject when he would be seeing him again and told him to think about what he had been doing so he wouldn't forget.

Session 2

One-third of each of the four training condition groups was seen one day, one week, or two weeks after this initial training session. The same training procedure used in Part C of Session 1 was repeated with a second list of 18 picture pairs for two study-test trials. Experimental subjects were

reminded of the training and instructed to apply it to this new instance of the task. They were given an example of the strategy for each new picture pair if unable to provide their own within 10 seconds. The pretraining procedure was repeated for the control subjects with a new list.

As in Session 1, E kept a complete record of responses as well as spontaneous associations and other comments made by S. A brief paragraph relating a global impression of the subject was also included for each session for later evaluation. Again, following the session, the experimenter told the S when he would be seen again and reminded him to think about what he had been doing on the task.

Session 3

All subjects were seen two weeks after Session 2. Two study-test trials were conducted with a new list for all subjects, using the procedures employed in the pretraining. After the second trial in this posttraining series, the experimental subjects were reminded of the strategy they had been using during training and encouraged to use it but no new examples were provided. Two additional study-test trials sequences were then administered using the same list. Control subjects were given four study-test trials with no intervening instructions.

Reminder Instructions for Experimental Subjects

Do you remember what you did the last time we looked at slides? (If subject doesn't recall, E reminds him of

the training.) That's right, you used sentences about the pictures (you pictured in your mind both of the pictures together) to help you remember what pictures went together each time. Let's take another turn. This time make up a sentence (try to picture in your mind both pictures together) for each of the picture pairs. (E shows the first slide.) Tell me your sentence for these two pictures (close your eyes and picture in your mind both pictures together, then tell me what you see).

Results

Several multivariate analyses of variance and covariance were performed with two factors (Treatment Group and Intersession Interval). The number of correct responses was used as the dependent measure. Three difference contrasts were obtained for Factor A (Treatment Group): A_1 (visual versus verbal training), A_2 (visual and verbal training compared with combined training), and A_3 (all three training groups compared with the control group). Orthogonal polynomial contrasts were obtained for Factor B (Intersession Training Interval). A linear trend (B_1) indicates a progressive increase in the scores of the one-day, one-week, and two-week dosage conditions. A quadratic trend (B_2) indicates a change in direction of scores across the three conditions with the one-week condition (the middle position) being highest or lowest.

Session 1

Pretraining competence. A multivariate analysis of mean scores on the two pretest trials revealed no significant

group or dosage contrast effects nor any interactions. In other words, all treatment groups were performing at initially comparable levels regardless of assignment to a dosage condition. (Mean scores for all groups on all trials of the study can be found in Stein, Gampel and Budoff, 1973.)

Effects of training. Looking at the training trials within Session 1 as the criteria, covaried by pretraining score, the training versus no training (A_3) contrast was significant ($F = 28.045$, $df = 2$, $p < .001$), indicating that trained subjects combined performed better than controls. There were no differences among training groups at the end of the first training session.

When the two training trials of the second training session were analyzed, only the training versus control contrast (A_3) proved to be significant ($F = 22.261$, $df = 2$, $p < .001$). There were no other significant contrasts for type of training or significant effects of interval between training sessions. Training on both Session 1 and Session 2 uniformly improved scores of experimental subjects.

Transfer of the training. When the first two trials of the posttraining session were used as the dependent variables with pretraining scores covaried, trained subjects taken as a whole performed significantly better than the controls ($F = 4.534$, $df = 2$, $p < .016$). Transfer of the training to a novel instance of the paired associates task occurred. The mean correct items on Trial 2 of the post session was 10.43 for

for all experimental subjects and 6.97 for the controls.

The significant interactions between the two factors indicated that the three training groups responded differently to the three inter-training intervals. The combined training group benefitted most from the two-week interval between training sessions [(sentence and imagery versus combined X inter-training interval, linear component) (A_2B_1) ($\underline{F}$ = 3.596, $\underline{df}$ = 2, $\underline{p} < .036$)]. In contrast, the imagery group performed more poorly as the length of the training interval increased with subjects receiving training after one day performing best [(sentence versus imagery X inter-training interval, linear component) (A_1B_1) ($\underline{F}$ = 4.330, $\underline{df}$ = 2, $\underline{p} < .020$)]. Subjects in the sentence mediation group gained most from training received at a one-week interval [(sentence versus imagery X inter-training interval, quadratic component) (A_1B_2) ($\underline{F}$ = 4.58, $\underline{df}$ = 2, $\underline{p} < .016$)]. Figure 1 summarizes these findings.

Insert Figure 1 about here

Transfer effects following the reminder. After the first two posttraining trials, experimental subjects were reminded of the training they had been given in the two earlier sessions. Following this brief reminder, which did not include any further training, two additional study-test trials were conducted. Using these two trials as the dependent variables and covarying the effects of the pretraining and posttraining trials, the

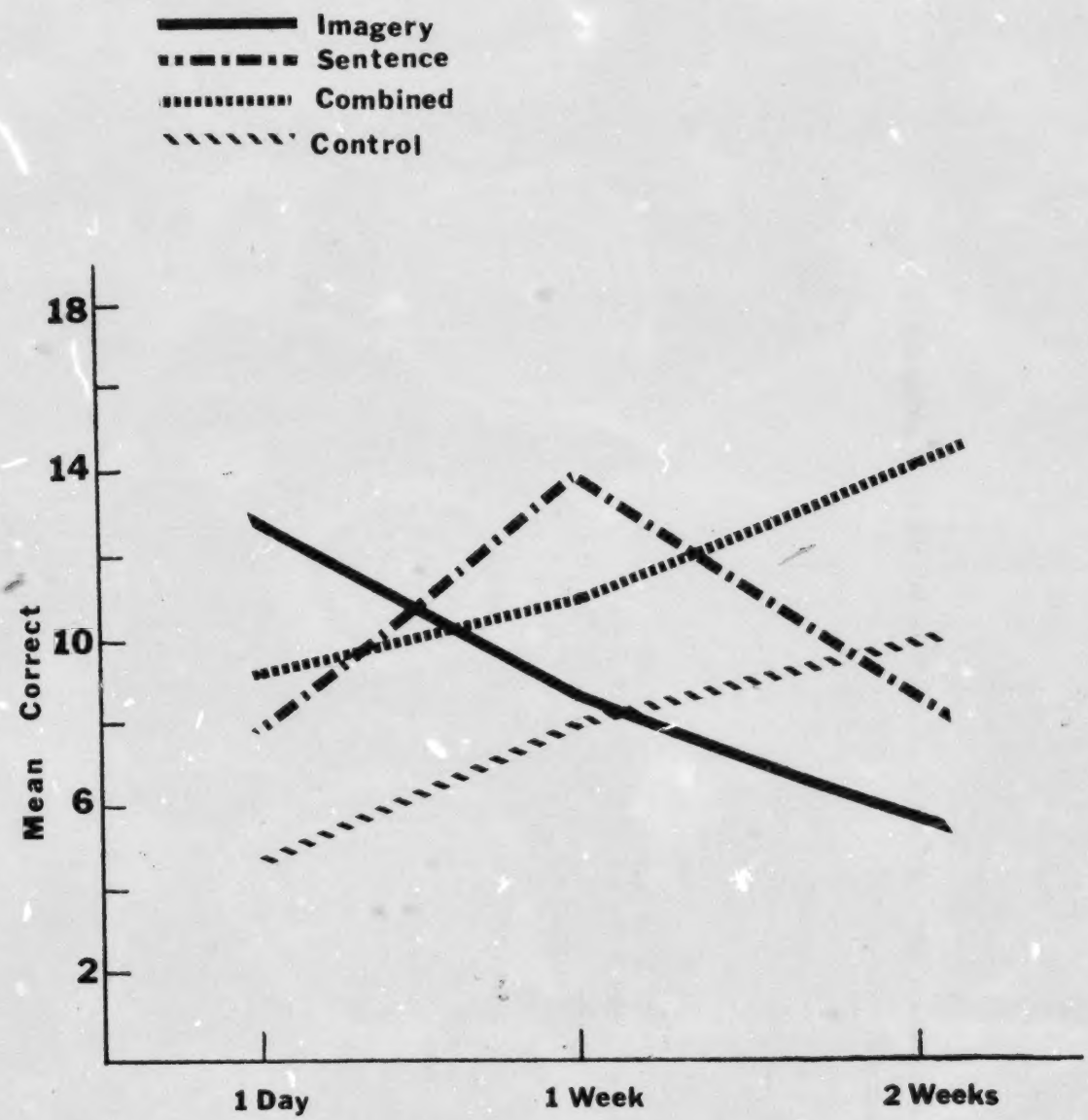

Figure 1. Training Group by Inter-Trial Interval Condition (Performance on Trial 2 of Posttraining Session).

trained versus nontrained (A_3) contrast remained significant ($F = 24.666$, $df = 2$, $p < .001$). The three experimental groups performed significantly better than the controls after the presentation of a reminder of previous training to trained subjects. On the second study-test trial after the reminder, the trained subjects performed at an almost perfect level ($\bar{X} = 17.11$). Control subjects increased their performance to only 12 correct choices with two more trials. Figure 2 summarizes the performance of the four training groups on the four posttraining trials. Both the superior performance of the trained subjects at the outset as well as their improvement after the reminder can be seen.

While there was no difference between the sentence-trained and imagery-trained subjects following the reminder, subjects receiving combined training performed at a lower level on this series when compared with the other training groups ($F = 8.913$, $df = 2$, $p < .001$). The only significant interaction of the training group and inter-training intervals (A_1B_2) indicated that sentence-trained subjects trained after a one-week interval performed better than those trained after one day or two weeks ($F = 3.674$, $df = 2$, $p < .034$). No other interactions were significant after introduction of the reminder.

Discussion

This study was undertaken to investigate the effects of type of strategy training, intersession interval, and a reminder cue on paired associates learning in an EMR pupulation. The results of the multivariate analysis of variance help illuminate

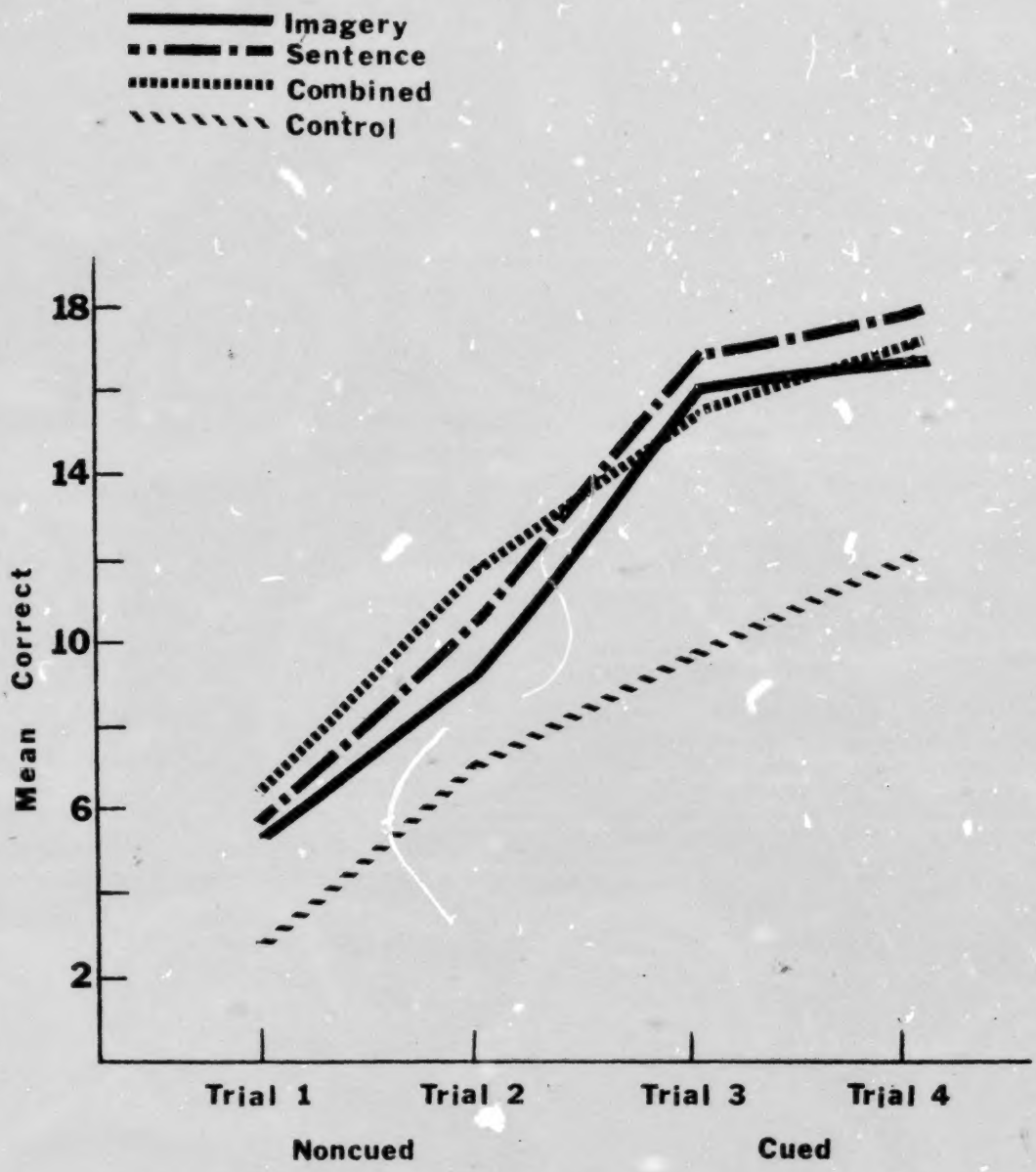

Figure 2. Posttraining Performance of the Four Training Groups.

the significance of these factors.

Spontaneous Transfer of Training Strategies: The Effects of Type of Strategy Training. There was a significant amount of transfer, as measured by performance on the posttraining trials across all training groups when compared to the control group. This finding differs from that of other investigators (e.g., Jensen & Rohwer, 1963a; MacMillan, 1970; Mankinen, 1972) who reported no differences between trained and control subjects on the posttest. Since the interval between training and posttest was the same in this study as in the others cited (two weeks), the differences may be due to the addition of the instruction to remember the strategy and to use it again. The design included a teaching or educational emphasis rather than the traditional controlled laboratory approach. Also, all subjects were administered two training sessions providing experience with the strategy with different stimulus materials. The usefulness of the strategy in a general sense was incorporated into the training program. In contrast, most previous studies include only one training session limited to a specific set of stimuli.

The lack of any significant contrasts other than the one comparing trained and control subjects indicates that there were no differences among the types of strategy training when intersession interval was controlled. None of the strategy training approaches better facilitated paired-associates learning either at the time of training or on the posttraining trials.

The Effect of Inter-Training Session Interval. We have noted that the different strategies did not differ from each other in terms of transfer to the posttraining session. Similarly, intersession interval, taken alone, did not differentially affect performance. However, the two factors did interact to influence performance. The one-day interval was maximally effective for the imagery training group, the one-week interval worked best for the sentence mediation training groups, and the two-week interval was most effective for the combined imagery and sentence mediation training group. It is possible that visual imagery training profits most from condensed dosing, and sentence mediation which involves the more complex verbal system, takes more time to consolidate. Neither of the two "pure" strategy training groups reaped maximum benefits from the longer, two-week duration, whereas the groups trained with both strategies simultaneously performed progressively better as the intersession interval increased.

We are proposing three tentative hypotheses to explain these findings. (a) Visual processing is best consolidated in memory as a strategy for learning by relatively condensed boosters; i.e., training repeated often within a short time. (b) Sorting and integrating verbal materials takes a longer time: training spaced over time best allows for this kind of processing. (c) Those processes even more complex such as combining two strategies are best facilitated by training that encompasses even more time. It is interesting to note that the control group receiving the two-week interval between Sessions 2 and 3

also performed better than the one-week or one-day control groups, although performance was at a consistently lower level than for the combined strategy group. Thus, it appears that the combined training may be functioning as practice on the task does to improve performance. The more widely spaced practice allows for the detection of spontaneous change.

A study with more extreme differences between dosage conditions and more intensive training is needed to test out this rationale. Studies of other temporal variables (Baumeister, Hawkins, & Davis, 1966) are as yet equivocal, but have reported sufficient positive results to suggest that the interval between training sessions is of relevance in facilitating learning among the retarded.

The Effect of the Reminder Cue. One startling result of this study was the abrupt improvement in performance demonstrated by trained subjects when they were reminded briefly that the previous training could be applied to the new list of stimuli. Strikingly, the reminder to use the trained strategy was sufficient to change the performance of the trained subjects. It appears to have served as a cue to produce the appropriate mediation. Performance on Trial 4 was nearly perfect for the trained subjects. The significant interactions of type of training and intersession training interval evident on the first two training trials were nearly all erased by the reminder cue. All trained subjects, regardless of the timing of their training benefited equally from the

reminder to use the facilitating strategy (although the combined strategy training group did not achieve scores quite as high as the other training groups).

This finding, along with the immediately elevated performance of all training groups on the first posttraining trial demonstrates the importance of the instructional as well as the skill dimension of cognitive training. We suggest that the training has two aspects. In addition to presenting the specific skill, the training provides an instruction to produce a strategy to actively mediate the items to be learned. In training, the child superimposes a new cue or orientation on a rote learning task: i.e., to pay less attention to rote memorization and more to making the material meaningful. At this point, the task changes and becomes easier for the subject since the specific mnemonic strategy almost assures immediate association. The subjects in our study appear to evidence a production deficiency. They do not spontaneously orient themselves in the absence of instruction and consequently do not "activate" the strategy/ as non-retarded children seem to do spontaneously. Certain aspects of the study such as the induced set to remember and the reminder cue help the subject overcome this deficiency and performance improves.

The problem is the retention of the cue that will set up the use of the strategy. From our work in this area, it does seem that we are not dealing with a conventional learning problem, but with a complex set of variables involving motivation, style of approach, and retention of the fact that an

easier way in available. The retention of the cue and the spontaneous self-instruction requires motivation as well as confidence in one's capacity to cope with a task. To perform well requires motivated memory search for a strategy which has worked in the past in similar situations. It is this active, positive involvement and the failure to spontaneously apply that which they have learned that characterizes retarded children perhaps because they have a failure expectancy (Zigler, 1967).

The fact that the retarded subjects remembered and spontaneously used the strategy they had been cued to use following the reminder in this experiment designed to foster transfer should be read as an encouraging sign for the education of these children. We are dealing here not with specific curricula but with one of the extra- or non-curricular aspects of education, i.e., learning how to learn. Nonretarded children seem to spontaneously learn how to learn. If we can identify what is involved in such learning, there is no reason to assume that we cannot then proceed to adapt curricula for their particular learning needs.

To conclude, we are in agreement with (1968) in his observation that, "differences in learning achievement... represent the products of different degrees of goodness of fit between the learner, the task, and, in particular, the instructional mode." The next step is to design changes in the instructional mode which will foster a better match between learner and task.

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Footnotes

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